US Army Corps of Engineers

DTIC FILE COPY

(2)

TECHNICAL REPORT HL-89-2

WEST ACCESS CHANNEL REALIGNMENT ATCHAFALAYA RIVER

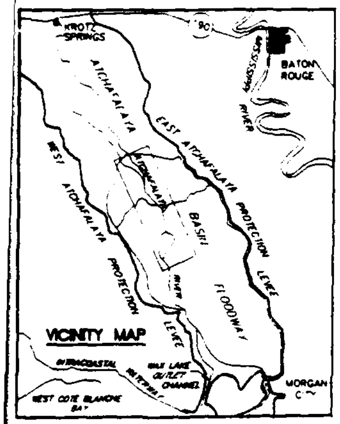
Hydraulic Model Investigation

by

D. M. Maggio, C. R. Nickles

Hydraulics Laboratory

DEPARTMENT OF THE ARMY
Waterways Experiment Station, Corps of Engineers
PO Box 631, Vicksburg, Mississippi 39181-0631



February 1989

Final Report

HYDRAULICS LABORATORY

Prepared for US Army Engineer District, New Orleans
New Orleans, Louisiana 70160-0267

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE

REPORT DOCUMENTATION PAGE

Form Approved OMB No. 0704-0188

1a. REPORT SECURITY CLASSIFICATION Unclassified	1b. RESTRICTIVE MARKINGS
2a. SECURITY CLASSIFICATION AUTHORITY	3. DISTRIBUTION/AVAILABILITY OF REPORT Approved for public release; distribution unlimited.
2b. DECLASSIFICATION/DOWNGRADING SCHEDULE	
4. PERFORMING ORGANIZATION REPORT NUMBER(S) Technical Report HL-89-2	5. MONITORING ORGANIZATION REPORT NUMBER(S)
6a. NAME OF PERFORMING ORGANIZATION USAEWES Hydraulics Laboratory 6b. OFFICE SYMBOL (If applicable) CEWES-HR-P	7a. NAME OF MONITORING ORGANIZATION
6c. ADDRESS (City, State, and ZIP Code) PO Box 631 Vicksburg, MS 39181-0631	7b. ADDRESS (City, State, and ZIP Code)
8a. NAME OF FUNDING/SPONSORING ORGANIZATION USAED, New Orleans 8b. OFFICE SYMBOL (If applicable)	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER
8c. ADDRESS (City, State, and ZIP Code) PO Box 60267 New Orleans, LA 70160-0267	10. SOURCE OF FUNDING NUMBERS PROGRAM ELEMENT NO. | PROJECT NO. | TASK NO. | WORK UNIT ACCESSION NO.

11. TITLE (Include Security Classification)
West Access Channel Realignment, Atchafalaya River; Hydraulic Model Investigation

12. PERSONAL AUTHOR(S)
Maggio, D. M., and Nickles, C. R.

13a. TYPE OF REPORT	13b. TIME COVERED	14. DATE OF REPORT (Year, Month, Day)	15. PAGE COUNT
Final report	FROM ______ TO ______	February 1989	23

16. SUPPLEMENTARY NOTATION
Available from National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161.

17. COSATI CODES

FIELD	GROUP	SUB-GROUP

18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)
Atchafalaya River
Channel alignment
Hydraulic models
Movable-bed model
West Access Channel

19. ABSTRACT (Continue on reverse if necessary and identify by block number)

The entrance of the West Access Channel has required frequent maintenance dredging to maintain flow distribution to the West Atchafalaya Protection Levee. The channel has had a history of shoaling to the extent that the amount of flow through the channel has been significantly reduced. Due to channel alignment and length, the flows in the channel are normally too small to move the sediment through the channel. A 1:120-horizontal- and 1:80-vertical-scale movable-bed model was used to study the effects of relocating the entrance about 2.7 miles upstream of the existing entrance on the sediment load entering the West Access Channel. This configuration exited the Atchafalaya River at approximately 90 deg and decreased the length of the channel about 1.5 miles. The model results indicated the new alignment would reduce the amount of bed material entering the channel to almost zero.

20. DISTRIBUTION/AVAILABILITY OF ABSTRACT ☒ UNCLASSIFIED/UNLIMITED ☐ SAME AS RPT. ☐ DTIC USERS	21. ABSTRACT SECURITY CLASSIFICATION Unclassified
22a. NAME OF RESPONSIBLE INDIVIDUAL	22b. TELEPHONE (Include Area Code) | 22c. OFFICE SYMBOL

DD Form 1473, JUN 86 — Previous editions are obsolete.

SECURITY CLASSIFICATION OF THIS PAGE

Unclassified

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE

PREFACE

The model investigation reported herein was conducted for the US Army Engineer District, New Orleans (LMN), in the Hydraulics Laboratory of the US Army Engineer Waterways Experiment Station (WES), Vicksburg, MS, during the period from March 1981 to October 1984. The investigation was conducted under the general supervision of Messrs. H. B. Simmons and F. A. Herrmann, Jr., former and present Chiefs of the Hydraulics Laboratory (HL), and under the direct supervision of Mr. J. E. Glover, former Chief of the Waterways Division, HL. The engineer in immediate charge of the investigation was Mr. T. J. Pokrefke, who was assisted by Messrs. C. R. Nickles and D. M. Maggio and Miss K. Anderson-Smith, all of the Potamology Branch, Waterways Division. This report was prepared by Messrs. Maggio and Nickles and edited by Mrs. M. C. Gay, Information Technology Laboratory, WES.

During the course of the model study, LMN was kept informed of the progress of the study through monthly progress reports and interim test results. Messrs. F. Chatry, C. Soileau, B. Garrett, and A. Laurent and Miss N. Powell of LMN made frequent visits to WES to observe model tests, discuss test results, and coordinate the testing program.

COL Dwayne G. Lee, EN, is the Commander and Director of WES. Dr. Robert W. Whalin is the Technical Director.

CONTENTS

	Page
PREFACE	1
CONVERSION FACTORS, NON-SI TO SI (METRIC) UNITS OF MEASUREMENT	3
PART I: INTRODUCTION	5
Description of the Problem	5
Purpose of the Model Study	5
PART II: THE MODEL	7
Description	7
Appurtenances	7
Model Verification	8
PART III: TESTS AND RESULTS	10
Test Procedure	10
Plan A	10
Plan A-Modified	11
PART IV: DISCUSSION OF RESULTS AND CONCLUSIONS	12
Interpretation of Model Results	12
Summary of Results and Conclusions	12
TABLE 1	
PLATES 1-6	

CONVERSION FACTORS, NON-SI TO SI (METRIC) UNITS OF MEASUREMENT

Non-SI units of measurement used in this report can be converted to SI (metric) units as follows:

Multiply	By	To Obtain
cubic feet	0.02831685	cubic metres
degrees (angle)	0.01745329	radians
feet	0.3048	metres
inches	25.4	millimetres
miles (US statute)	1.609344	kilometres

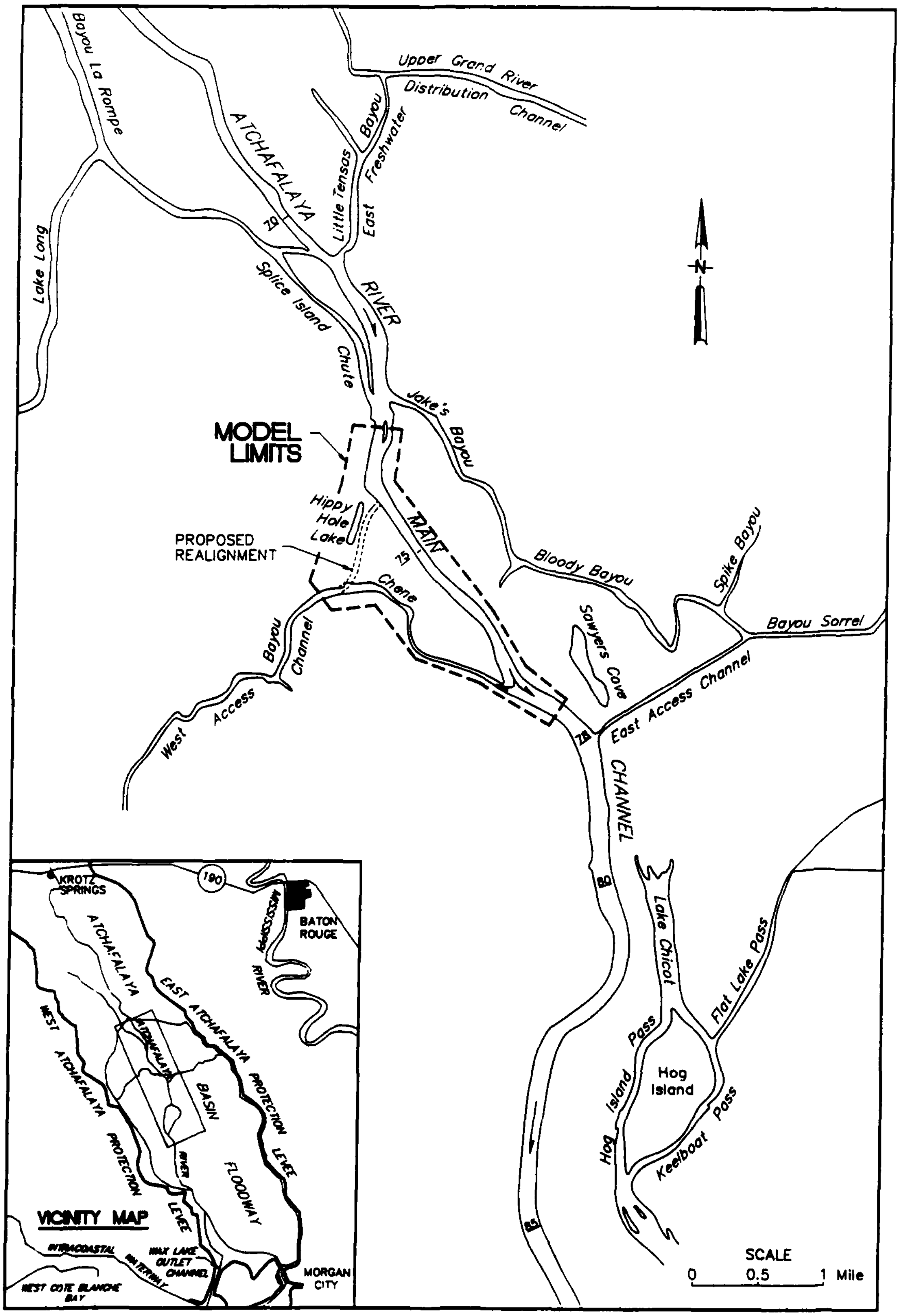


Figure 1. Location and vicinity map

WEST ACCESS CHANNEL REALIGNMENT, ATCHAFALAYA RIVER

Hydraulic Model Investigation

PART I: INTRODUCTION

1. This report presents the results of a movable-bed model investigation concerned with the development of plans for the realignment of the entrance of the Atchafalaya River West Access Channel, Louisiana. The West Access Channel, also referred to as Bayou Chene (Figure 1), is a water distributary channel from the Atchafalaya River to the channel adjacent the West Atchafalaya Protection Levee. Plans tested were proposed by the US Army Engineer District, New Orleans, in collaboration with representatives of the US Army Engineer Waterways Experiment Station (WES), and were designed to provide a channel that would require a minimum of maintenance dredging.

Description of the Problem

2. The entrance of the West Access Channel has been an area requiring frequent maintenance dredging to maintain flow distribution to the West Atchafalaya Protection Levee. The entrance is located at Atchafalaya River mile 76.8,* which is approximately 37 river miles downstream of Krotz Springs, LA, and 40 miles upstream of Morgan City, LA (Figure 1). The West Access Channel has had a history of shoaling to the extent that the amount of flow through the channel has been significantly reduced. Due to the channel alignment and length, the flows in the channel are normally too small to move the sediment through the channel; therefore, frequent dredging of the channel is required.

Purpose of the Model Study

3. A plan was proposed by the New Orleans District to relocate the entrance of the West Access Channel approximately 3 miles** upstream of its

---

* Atchafalaya River miles (1975).

** A table of factors for converting non-SI units of measurements to SI (metric) units is presented on page 3.

present site and realign the upper portion of the channel. The model study was undertaken to obtain some indication of the effectiveness of the proposed relocation and realignment to reduce the sediment entering the channel and the effects on the Atchafalaya River Channel.

PART II: THE MODEL

Description

4. The movable-bed model used for this study reproduced to a horizontal scale of 1:120 and a vertical scale of 1:80 the reach of the Atchafalaya River between miles 72.9 and 77.4, including the entrance and approximately 2.9 miles of the upstream end of the West Access Channel. The scales selected resulted in a distortion of the linear scale of 1.5, which is acceptable for a model of this type. This area reproduced sufficient sections of the Atchafalaya and West Access Channels above and below the existing and proposed alignments to study the problem. The model was constructed with the banks fixed above el 0.0* and the overbank areas molded in sand-cement mortar. The Atchafalaya River Channel below el 0.0 from mile 72.9 to mile 75.8 was reproduced using 3/4-in. crushed stone. This area was fixed after a study of geological surveys and prior hydrographic surveys of the channel indicated that the river channel was entrenched in a layer of back-swamp clay, which is highly resistant to erosion. The remaining river channel from mile 75.8 to mile 77.4 and the West Access Channel were molded in crushed coal having a median diameter of 2 mm and a specific gravity of 1.30.

5. Overbank portions of the model were molded in accordance with data shown on US Geological Survey maps; the Atchafalaya River Channel was molded to a June 1975 prototype hydrographic survey; and the West Access Channel was molded to data from 1975 after dredging cross sections, herein referred to as the June 1975 prototype survey (Plate 1).

Appurtenances

6. Water was supplied to the model by a 10-cfs axial flow pump operating in a recirculating system and was measured with 12- by 6- and 6- by 3-in. venturi meters. Water-surface elevations in the model were controlled by slide-type tailgates at the downstream ends of the Atchafalaya River and the West Access Channels and were measured by piezometers located approximately

---

* All elevations (el) and stages cited herein are in feet referred to the National Geodetic Vertical Datum (NGVD).

one-half mile apart in each channel. Discharge through the West Access Channel was measured by calibration of the tailgate at the end of the channel. A graduated container was used to measure the material introduced at the upstream end of the model. A sediment trap was provided at the downstream end of each channel where sediment extruded from the model could accumulate and be measured when desired. A carefully graded rail was installed along each side of both channels to support sheet metal templates used for molding the model bed prior to initiation of certain tests. These rails were also used to provide vertical control for surveying the model bed.

Model Verification

7. Before a movable-bed model is used to test the effectiveness of proposed improvement plans, its ability to reproduce conditions similar to those that can be expected in the prototype must be demonstrated. Complete similarity between the model and prototype is seldom obtained because of the inherent distortions incorporated in the design and in the operation of the model. Because of these dissimilarities, the degree of reliability of this type of model cannot be fully established by mathematical analysis and must be based on model verification. Verification of the model involves the adjustment of various hydraulic forces, time scale, rate of introducing bed material, and model operating techniques until the model reproduces, with acceptable accuracy, the changes known to have occurred in the prototype during a given period. Various scale relationships and model operating procedures established during model verification are used in tests of improvement plans. The degree of similarity between the model and prototype data obtained during model verification is considered in the analysis of the model data.

8. Normal verification of a movable-bed model consists of molding the model to a prototype survey and reproducing the prototype discharge and stage hydrographs that occurred from that survey until the next prototype survey, usually for one year. However, due to nonregular survey intervals and the historical stability of the bed in the modeled reach, it was considered adequate for this study to verify the model to a stable bed configuration. Verification of the model was started with the model molded to the conditions described in paragraph 5. The model was then operated by reproducing a blocked hydrograph representing flows that occurred in the prototype from January to

December 1976. These flows and the corresponding stages are shown in Plate 2 and Table 1. The operation of the model was repeated and adjustments were made until the model reproduced the essential characteristics and bed configuration of the reach.

9. Results of the verification test, shown in Plate 3, indicate that the model reproduced the general characteristics of the prototype reach, and the verification was considered adequate for the purpose of the study. Comparison of the results of the model verification with the 1975 prototype survey (Plate 1) indicated that the crossing in the middle of the model and the entrance of the West Access Channel were somewhat deeper than indicated in the prototype survey. Shoaling in the West Access Channel was somewhat less in the model than what has been experienced in the prototype. Approximately 32 percent of the model bed load was diverted from the main channel into the West Access Channel. The actual percentage diverted in the prototype is unknown. These differences and tendencies have to be considered in the evaluation of the results of the test of improvement plans. For a detailed description of the verification process, see Franco (1978).*

---

* J. J. Franco. 1978 (Aug). "Guidelines for the Design, Adjustment, and Operation of Models for the Study of River Sedimentation Problems," Instruction Report H-78-1, US Army Engineer Waterways Experiment Station, Vicksburg, MS.

PART III: TESTS AND RESULTS

Test Procedure

10. Normally, after verification of the model, tests using the existing conditions, referred to as base tests, are conducted to determine channel development with one or more reproductions of an average annual hydrograph and to provide a basis for comparing the effects of various improvement plans. Because of the procedure used for the verification of the model and because the annual hydrograph used for testing of all improvement plans was the same January-December 1976 prototype hydrograph (Plate 2) used for verification, base tests were considered unnecessary and the verification was adequate for comparison of the results of improvement plans. Each reproduction of the hydrograph is herein referred to as a run. Testing of the initial improvement plan was started with the bed molded to the June 1975 prototype survey, except that the West Access Channel was dredged to el -10.0. Subsequent tests were started with the bed configuration obtained at the end of the preceding test. The bed of the model was surveyed and mapped, the West Access Channel was redredged to el -10.0, and the material was measured to determine the bed load removed from the reach at the end of each run. Only final results or significant changes produced by each plan are included in this report.

Plan A

Description

11. Plan A consisted of realigning the upper end of the West Access Channel and placing a closure structure across the existing entrance of the channel. Plate 4 shows the realignment and channel cross section used for Plan A. The entrance of the existing channel was closed and a new channel entrance was located at approximately mile 74.1, or about 2.7 miles upstream of the existing channel entrance. The new channel exited the Atchafalaya River at approximately 90 deg and extended approximately 1.2 miles, making a smooth transition to tie into the existing West Access Channel. This configuration reduced the length of the West Access Channel about 1.5 miles. The new channel had a bottom width of 90 ft at el -10.0 with 1V on 3H side slopes.

Results

12. The results of tests of Plan A are shown in Plate 5. The results of sediment measurements indicated that the bed-load sediments diverted from the main channel into the realigned West Access Channel were reduced to less than 1 percent of the amount that enters the existing West Access Channel entrance. Alignment of the Atchafalaya River was unchanged by the realignment of the West Access Channel, except for some shoaling in the deeper portions of the river below el -40. This was caused by the increase in sediment carried in the river, but was not considered enough to significantly alter the river's stage-discharge relationship below the new alignment. Visual observations at the entrance of the new channel indicated that the current patterns entering the channel were poorly aligned and could cause severe attack on the downstream side of the entrance.

Plan A-Modified

Description

13. Plan A-Modified was the same as Plan A except the entrance of the realigned channel was curved upstream to provide better entrance flow conditions. The right side of the entrance was curved at a radius of 400 ft and the left side at a radius of 700 ft (Plate 4).

Results

14. The results of Plan A-Modified are shown in Plate 6. The results of sediment measurements indicated the diverted sediments were the same as with Plan A. The Atchafalaya River Channel below the new entrance was about the same as Plan A, but the current patterns entering the realigned West Access Channel were aligned satisfactorily.

PART IV: DISCUSSION OF RESULTS AND CONCLUSIONS

Interpretation of Model Results

15. The limitations of the model in reproducing all of the factors affecting developments in the reach and the differences between the model and prototype indicated by the results of verification tests must be considered in the evaluation of the model results. Results of tests of improvement plans should be based on only those changes caused by these plans compared with the results reproduced in the model during the verification. It should also be considered that the model does not reproduce the movement of material in suspension, and that the bank lines were fixed, with no attempt made to reproduce the degree of erodibility of the banks and sandbars. Also to be considered is the 1976 hydrograph used for testing of plans, which could be considerably different from what actually occurs in the river in the future, and the fact that the model surveys were always made during low-water periods.

Summary of Results and Conclusions

16. The indications and conclusions developed from the results of model tests are summarized as follows:

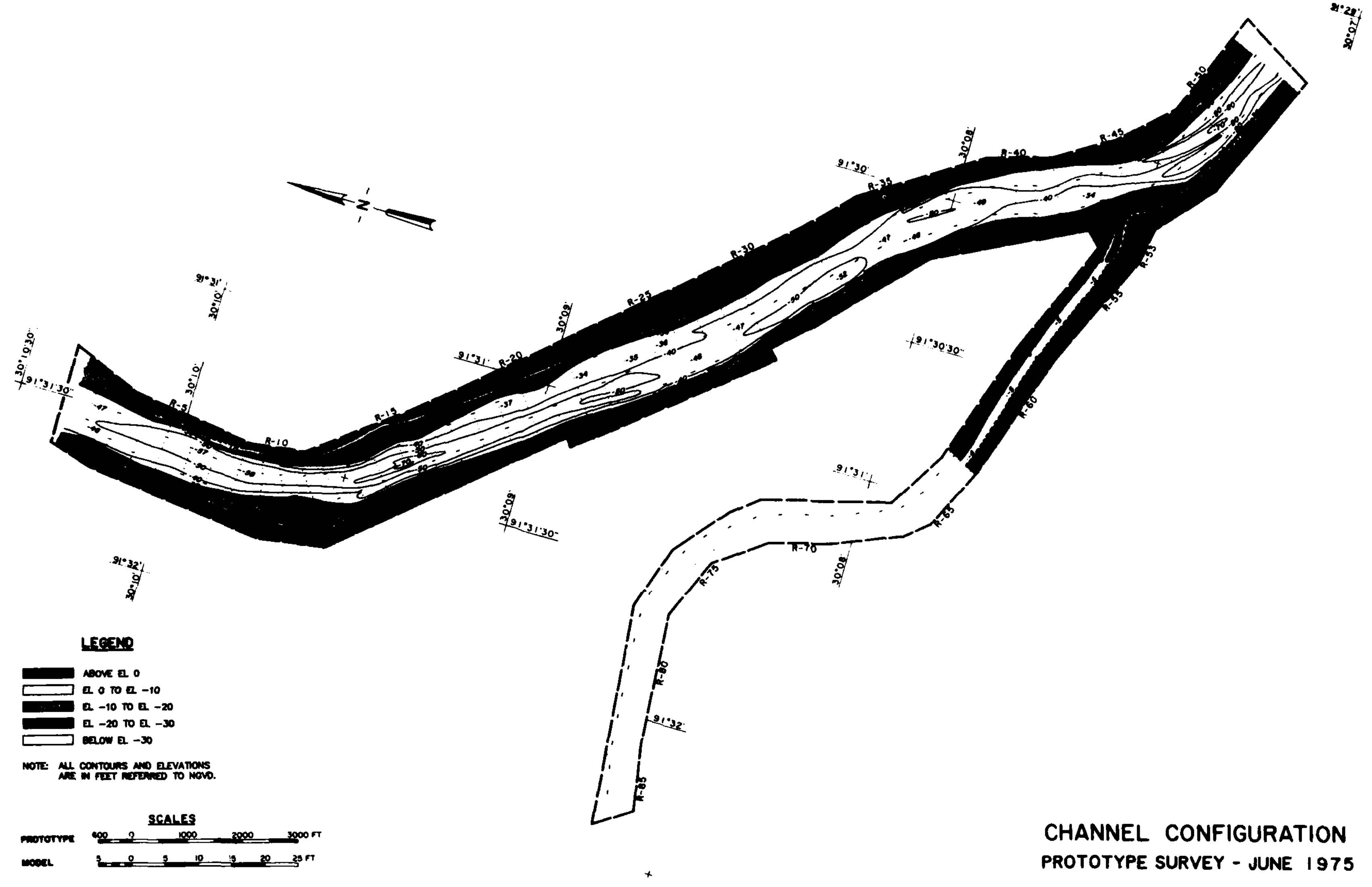
- a. Realigning of the entrance of the West Access Channel in Plan A reduced the bed-load sediments entering to less than 1 percent of existing conditions.
- b. The realignment in Plan A produced some shoaling of the deeper portions of the Atchafalaya River, below el -40, but it is believed that this change was not enough to significantly affect stages on the river below the realigned channel.
- c. Alignment of the new entrance of the West Access Channel in Plan A produced unsatisfactory current patterns that could cause severe attack on the downstream side of the entrance.
- d. Realignment of the entrance of the new channel in Plan A-Modified produced satisfactory current patterns entering the entrance of the channel.
- e. Plan A-Modified produced the same diverted bed-load sediments and effects on the Atchafalaya River Channel as obtained with Plan A.

Table 1

Prototype Stages and Discharges

January-December 1976

Stage at Entrance of West Access Channel	Discharge, cfs: Atchafalaya River Above West Access Channel	Discharge, cfs: West Access Channel
10.0	178,225	3,175
12.0	220,465	4,255
10.0	178,225	3,175
8.0	140,800	2,303
12.0	220,465	4,255
14.5	286,962	6,067
16.0	336,850	7,545
15.5	316,875	6,940
13.0	245,960	4,931
10.0	178,255	3,175
8.0	140,800	2,303
6.0	106,800	1,587
9.0	159,250	2,721
5.0	86,920	1,205
4.0	62,445	775
3.0	25,732	241
5.0	86,920	1,205
4.0	62,445	775
6.0	106,800	1,587



CHANNEL CONFIGURATION
PROTOTYPE SURVEY - JUNE 1975

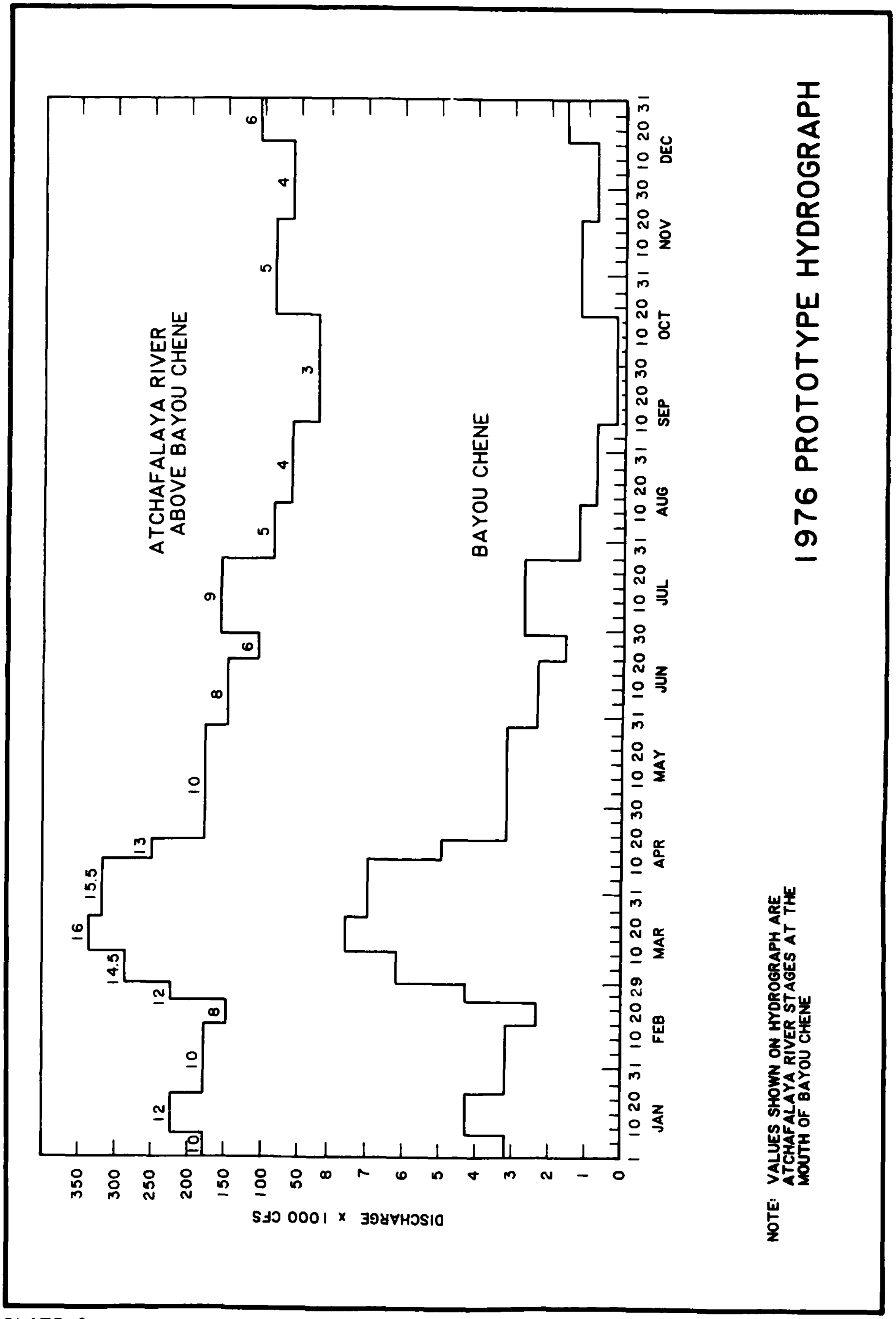
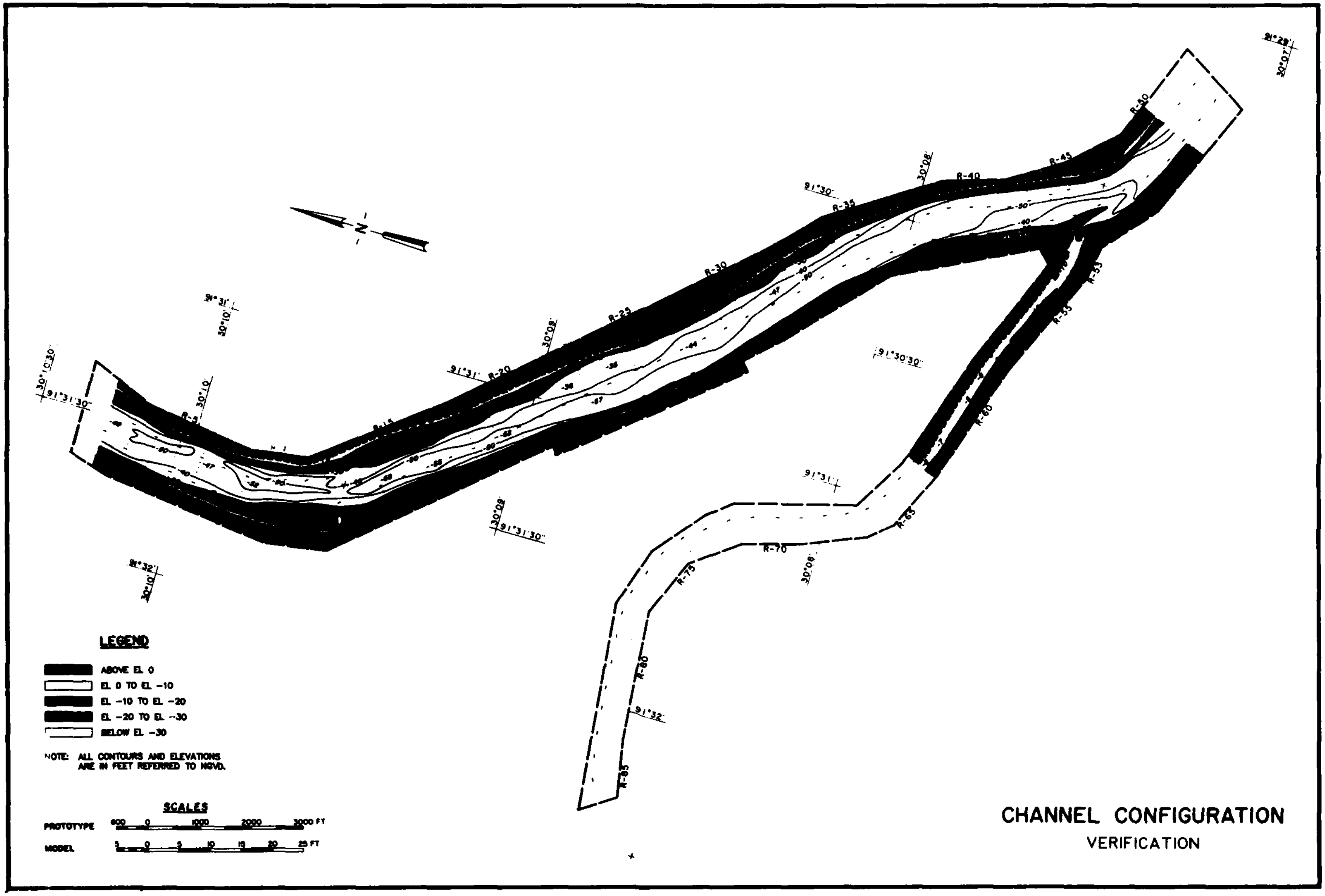
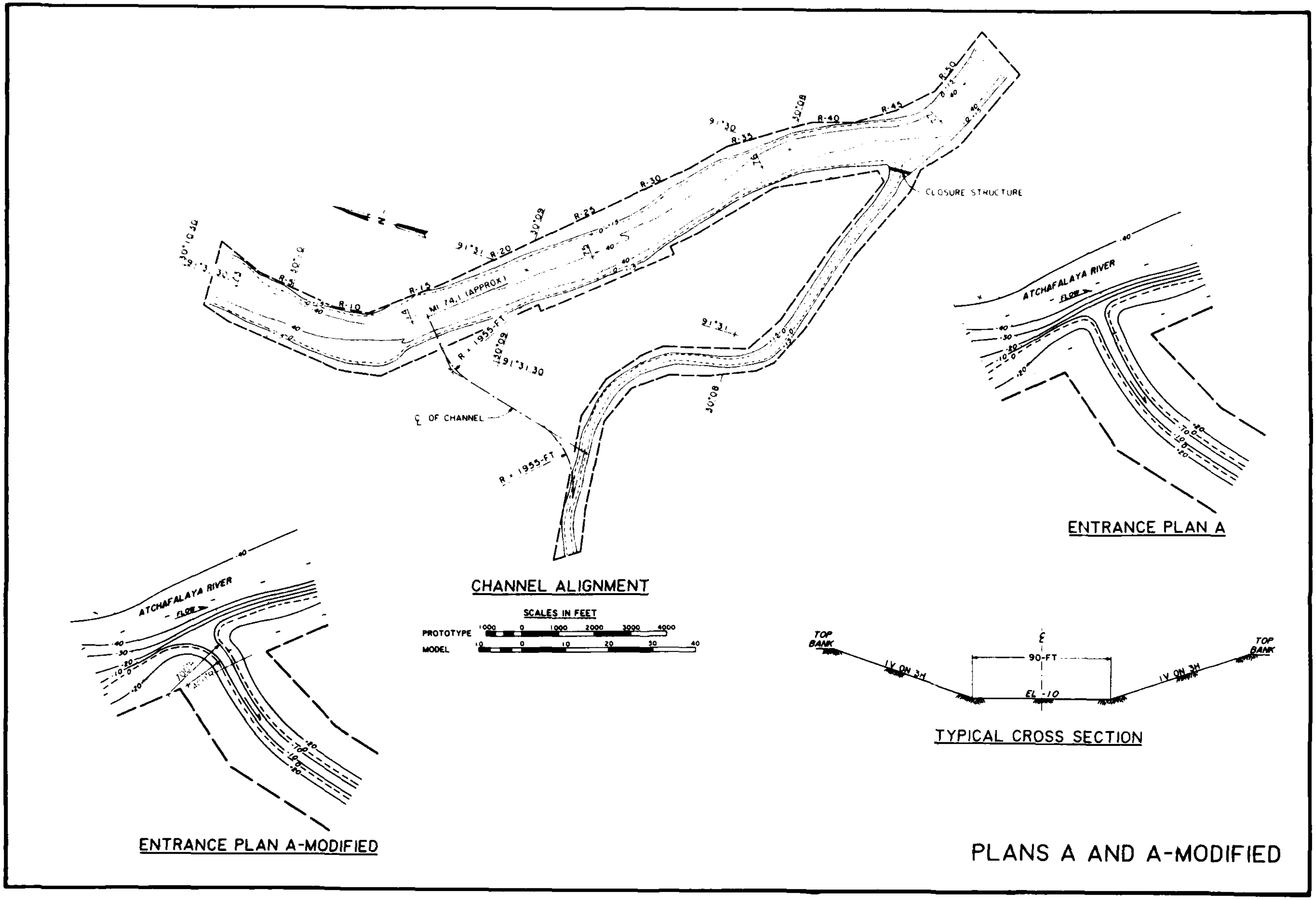

1976 PROTOTYPE HYDROGRAPH
ATCHAFALAYA RIVER
ABOVE BAYOU CHENE
BAYOU CHENE
DISCHARGE x 1000 CFS
350
300
250
200
150
100
50
8
7
6
5
4
3
2
1
0
10 12 10 8 12 14.5 16 15.5 13 10 8 6 9 5 4 3 5 4 6
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC
NOTE: VALUES SHOWN ON HYDROGRAPH ARE ATCHAFALAYA RIVER STAGES AT THE MOUTH OF BAYOU CHENE

PLATE 2

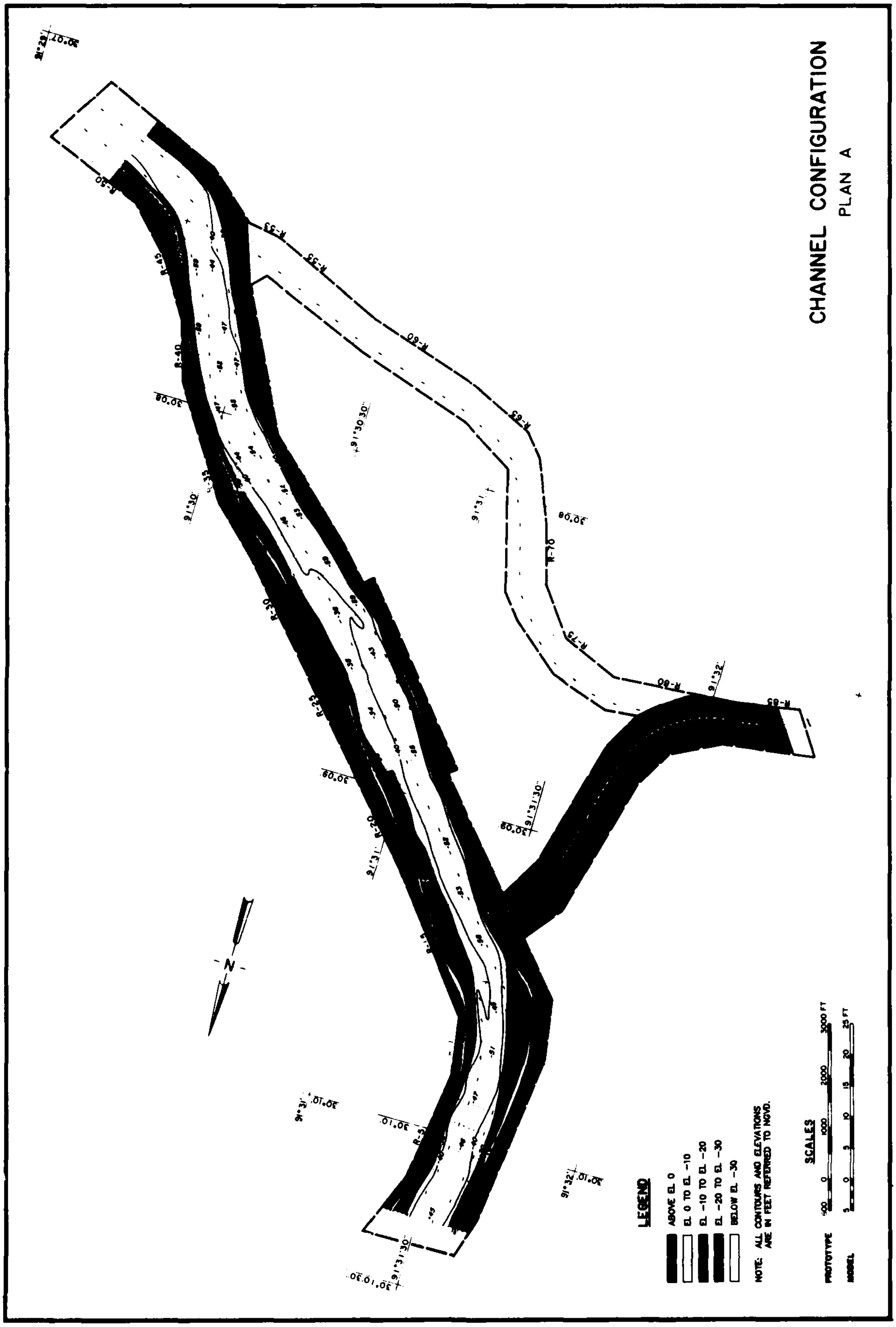


CHANNEL CONFIGURATION
VERIFICATION



PLANS A AND A-MODIFIED

PLATE 4



CHANNEL CONFIGURATION
PLAN A
LEGEND
ABOVE EL 0
EL 0 TO EL -10
EL -10 TO EL -20
EL -20 TO EL -30
BELOW EL -30
NOTE: ALL CONTOURS AND ELEVATIONS ARE IN FEET REFERRED TO NGVD.
SCALES
PROTOTYPE 500 0 1000 2000 3000 FT
MODEL 5 0 5 10 15 20 25 FT
N

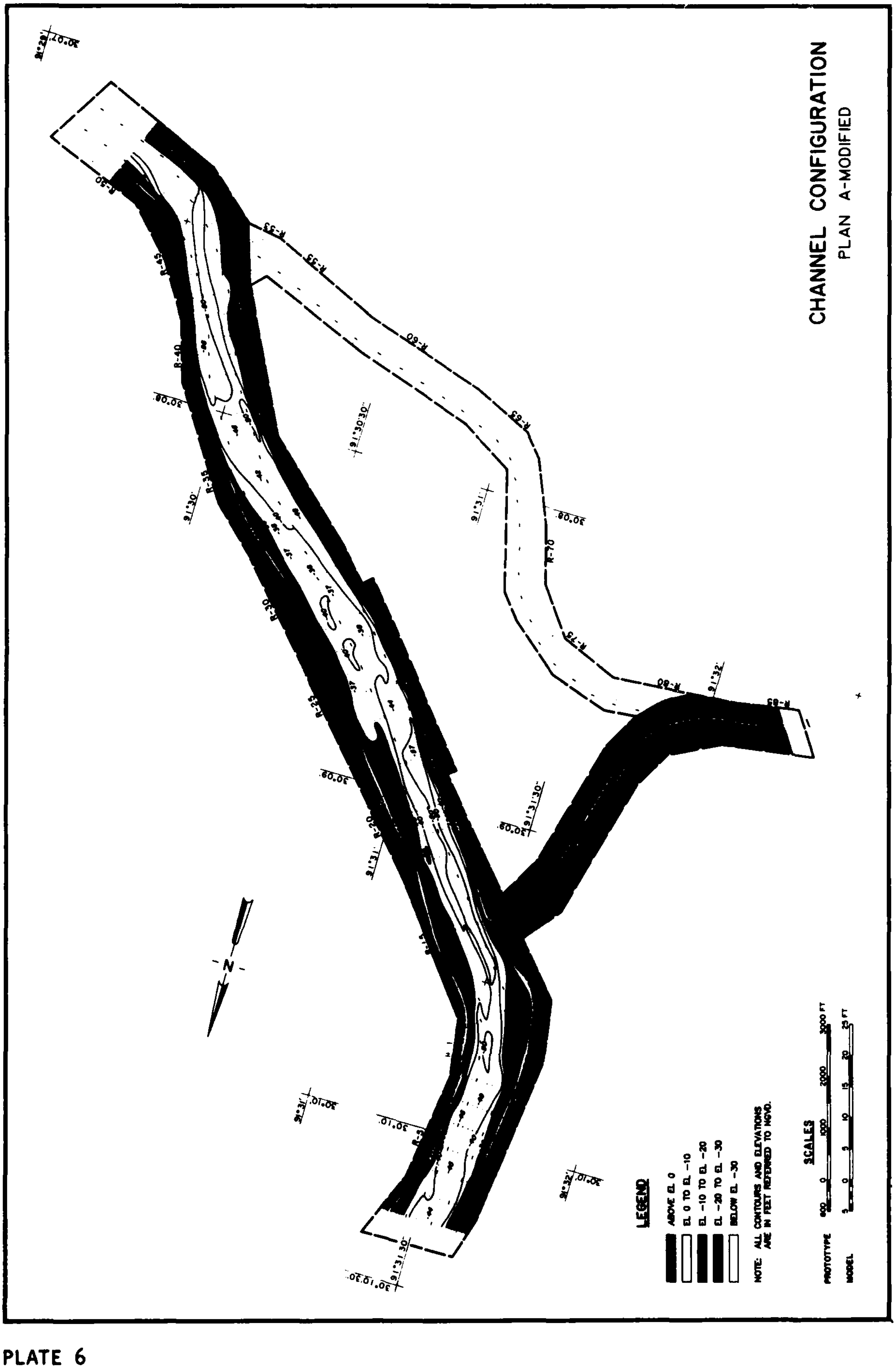

CHANNEL CONFIGURATION
PLAN A-MODIFIED
LEGEND
ABOVE EL 0
EL 0 TO EL -10
EL -10 TO EL -20
EL -20 TO EL -30
BELOW EL -30
NOTE: ALL CONTOURS AND ELEVATIONS ARE IN FEET REFERRED TO NGVD.
SCALES
PROTOTYPE
MODEL
N

PLATE 6